Outline

1. Reference Dependence: Housing

2. Reference Dependence: Disposition Effect

3. Reference Dependence: Equity Premium

4. Reference Dependence: Employment and Effort
1 Reference Dependence: Housing

- Genesove-Mayer (QJE, 2001)
  - For houses sales, natural reference point is previous purchase price
  - Loss Aversion $\rightarrow$ Unwilling to sell house at a loss

- Formalize intuition.
  - Seller chooses price $P$ at sale
  - Higher Price $P$
    * lowers probability of sale $p(P)$ (hence $p'(P) < 0$)
    * increases utility of sale $U(P)$
  - If no sale, utility is $\bar{U} < U(P)$ (for all relevant $P$)
• Maximization problem:

\[
\max_P p(P)U(P) + (1 - p(P))\bar{U}
\]

• F.o.c. implies

\[
MG = p(P)U'(P) = -p'(P)(U(P) - \bar{U}) = MC
\]

• Interpretation: Marginal Gain of increasing price equals Marginal Cost

• S.o.c are

\[
2p'(P)U'(P) + p(P)U''(P) + p''(P)(U(P) - \bar{U}) < 0
\]

• Need \( p''(P)(U(P) - \bar{U}) < 0 \) or not too positive
• Reference-dependent preferences with reference price $P_0$:

$$v(P|P_0) = \begin{cases} 
P - P_0 & \text{if } P \geq P_0; \\
\lambda(P - P_0) & \text{if } P < P_0,
\end{cases}$$

– Can write as

$$p(P) = -p'(P)(P - P_0 - \bar{U}) \text{ if } P \geq P_0$$

$$p(P)\lambda = -p'(P)(\lambda(P - P_0) - \bar{U}) \text{ if } P < P_0$$

– Plot Effect on MG and MC of loss aversion
• Case 1. Loss Aversion $\lambda$ increase price

• Case 2. Loss Aversion $\lambda$ induces bunching at $P = P_0$
• Case 3. Loss Aversion has no effect \((P > P_0)\)

• General predictions. When aggregate prices are low:
  – High prices \(P\) relative to fundamentals
  – Lower probability of sale \(p(P)\)
  – Longer waiting on market
• Evidence: Data on Boston Condominiums, 1990-1997

• Substantial market fluctuations of price
• Observe:
  
  – Listing price $L_{i,t}$ and last purchase price $P_0$
  
  – Observed Characteristics of property $X_i$
  
  – Time Trend of prices $\delta_t$

• Define:

  – $\hat{P}_{i,t}$ is market value of property $i$ at time $t$

• Ideal Specification:

  \[ L_{i,t} = \hat{P}_{i,t} + m \mathbf{1}_{\hat{P}_{i,t}<P_0} (P_0 - \hat{P}_{i,t}) + \varepsilon_{i,t} \]
  
  \[ = \beta X_i + \delta_t + \nu_i + m \text{Loss}^* + \varepsilon_{i,t} \]
• However:
  – Do not observe $\hat{P}_{i,t}$, given $v_i$ (unobserved quality)
  – Hence do not observe $Loss^*$

• Two estimation strategies to bound estimates. \textit{Model 1:}

$$L_{i,t} = \beta X_i + \delta_t + m \mathbf{1}_{\hat{P}_{i,t} < P_0} (P_0 - \beta X_i - \delta_t) + \varepsilon_{i,t}$$

  – This model overstate the loss for high unobservable homes (high $v_i$)
  – Bias upwards in $\hat{m}$, since high unobservable homes should have high $L_{i,i}$

• \textit{Model 2:}

$$L_{i,t} = \beta X_i + \delta_t + \alpha (P_0 - \beta X_i - \delta_t) + m \mathbf{1}_{\hat{P}_{i,t} < P_0} (P_0 - \beta X_i - \delta_t) + \varepsilon_{i,t}$$

• Estimates of impact on sale price
<table>
<thead>
<tr>
<th>Variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All listings</td>
<td>All listings</td>
<td>All listings</td>
<td>All listings</td>
<td>All listings</td>
<td>All listings</td>
</tr>
<tr>
<td>LOSS</td>
<td>0.35</td>
<td>0.25</td>
<td>0.63</td>
<td>0.53</td>
<td>0.35</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>LOSS-squared</td>
<td></td>
<td>-0.26</td>
<td>-0.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTV</td>
<td>0.06</td>
<td>0.05</td>
<td>0.03</td>
<td>0.03</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Estimated value in 1990</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Estimated price index at quarter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of entry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual from last sale price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months since last sale</td>
<td>-0.0002</td>
<td>-0.0003</td>
<td>-0.0002</td>
<td>-0.0003</td>
<td>-0.0002</td>
<td>-0.0003</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>Dummy variables for quarter of</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>entry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.77</td>
<td>-0.70</td>
<td>-0.84</td>
<td>-0.77</td>
<td>-0.88</td>
<td>-0.86</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.14)</td>
<td>(0.13)</td>
<td>(0.14)</td>
<td>(0.10)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.85</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>Number of observations</td>
<td>5792</td>
<td>5792</td>
<td>5792</td>
<td>5792</td>
<td>5792</td>
<td>5792</td>
</tr>
</tbody>
</table>
- Effect of experience: Larger effect for owner-occupied

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS × owner-occupant</td>
<td>0.50</td>
<td>0.42</td>
<td>0.66</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
<td>(0.08)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>LOSS × investor</td>
<td>0.24</td>
<td>0.16</td>
<td>0.58</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.12)</td>
<td>(0.06)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>LOSS-squared × owner-occupant</td>
<td></td>
<td>-0.16</td>
<td>-0.17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.14)</td>
<td>(0.15)</td>
<td></td>
</tr>
<tr>
<td>LOSS-squared × investor</td>
<td></td>
<td>-0.30</td>
<td>-0.29</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>LTV × owner-occupant</td>
<td>0.03</td>
<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>LTV × investor</td>
<td>0.053</td>
<td>0.053</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.027)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Dummy for investor</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.03</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Estimated value in 1990</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Estimated price index at quarter of entry</td>
<td>0.84</td>
<td>0.80</td>
<td>0.86</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Residual from last sale price</td>
<td>0.08</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Some effect also on final transaction price

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) All listings</th>
<th>(2) All listings</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS</td>
<td>0.18</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>LTV</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Residual from last sale price</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
</tr>
<tr>
<td>Months since last sale</td>
<td>-0.0001</td>
<td>-0.0004</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>Dummy variables for quarter of entry</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>3413</td>
<td>3413</td>
</tr>
</tbody>
</table>

**TABLE VI**
LOSS AVERSION AND TRANSACTION PRICES
DEPENDENT VARIABLE: LOG (TRANSACTION PRICE)
NLLS equations, standard errors are in parentheses.
• Lowers the exit rate (lengthens time on the market)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All listings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOSS</td>
<td>-0.33</td>
<td>-0.63</td>
<td>-0.59</td>
<td>-0.90</td>
</tr>
<tr>
<td>(0.13)</td>
<td>(0.15)</td>
<td>(0.16)</td>
<td>(0.18)</td>
<td></td>
</tr>
<tr>
<td>LOSS-squared</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.27</td>
<td>0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.07)</td>
<td>(0.07)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTV</td>
<td>-0.08</td>
<td>-0.09</td>
<td>-0.06</td>
<td>-0.06</td>
</tr>
<tr>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Estimated value in 1990</td>
<td>0.27</td>
<td>0.27</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Residual from last sale</td>
<td>0.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
</tbody>
</table>

• Overall, plausible set of results that show impact of reference point
  – Would have been nice to tie better to model
2 Reference Dependence: Disposition Effect

- Odean (JF, 1998)

- Do investors sell winning stocks more than losing stocks?

- Tax advantage to sell losers
  - Can post a deduction to capital gains taxation
  - Stronger incentives to do so in December, so can post for current tax year
Prospect theory intuition:
- Evaluate stocks regularly
- Reference point: price of purchase
- Convexity over losses $\rightarrow$ gamble, hold on stock
- Concavity over gains $\rightarrow$ risk aversion, sell stock
• Individual trade data from Discount brokerage house (1987-1993)

• Rare data set — Most financial data sets carry only aggregate information

• Share of realized gains:

\[
PGR = \frac{\text{Realized Gains}}{\text{Realized Gains} + \text{Paper Gains}}
\]

• Share of realized losses:

\[
PLR = \frac{\text{Realized Losses}}{\text{Realized Losses} + \text{Paper Losses}}
\]

• These measures control for the availability of shares at a gain or at a loss
• Notes on construction of measure:
  
  – Use only stocks purchased after 1987
  
  – Observations are counted on all *days* in which a sale or purchase occurs
  
  – On those days the paper gains and losses are counted
  
  – Reference point is *average* purchase price
  
  – PGR and PLR ratios are computed using data over all observations.
  
  – Example:

\[
PGR = \frac{13,883}{13,883 + 79,658}
\]
• Result: \( PGR > PLR \) for all months, except December

Table I

<table>
<thead>
<tr>
<th></th>
<th>Entire Year</th>
<th>December</th>
<th>Jan.–Nov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR</td>
<td>0.098</td>
<td>0.128</td>
<td>0.094</td>
</tr>
<tr>
<td>PGR</td>
<td>0.148</td>
<td>0.108</td>
<td>0.152</td>
</tr>
<tr>
<td>Difference in proportions</td>
<td>−0.050</td>
<td>0.020</td>
<td>−0.058</td>
</tr>
<tr>
<td>( t )-statistic</td>
<td>−35</td>
<td>4.3</td>
<td>−38</td>
</tr>
</tbody>
</table>

• Strong support for disposition effect
- Effect monotonically decreasing across the year

- Tax reasons are also at play
• Robustness: Across years and across types of investors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire year PLR</td>
<td>0.126</td>
<td>0.072</td>
<td>0.079</td>
<td>0.296</td>
</tr>
<tr>
<td>Entire year PGR</td>
<td>0.201</td>
<td>0.115</td>
<td>0.119</td>
<td>0.452</td>
</tr>
<tr>
<td>Difference in proportions</td>
<td>−0.075</td>
<td>−0.043</td>
<td>−0.040</td>
<td>−0.156</td>
</tr>
<tr>
<td>t-statistic</td>
<td>−30</td>
<td>−25</td>
<td>−29</td>
<td>−22</td>
</tr>
</tbody>
</table>

• Alternative Explanation 1: **Rebalancing** → Sell winners that appreciated
  – Remove partial sales

<table>
<thead>
<tr>
<th></th>
<th>Entire Year</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR</td>
<td>0.155</td>
<td>0.197</td>
</tr>
<tr>
<td>PGR</td>
<td>0.233</td>
<td>0.162</td>
</tr>
<tr>
<td>Difference in proportions</td>
<td>−0.078</td>
<td>0.035</td>
</tr>
<tr>
<td>t-statistic</td>
<td>−32</td>
<td>4.6</td>
</tr>
</tbody>
</table>
• Alternative Explanation 2: **Ex-Post Return** $\rightarrow$ Losers outperform winners ex post

– Table VI: Winners sold outperform losers that could have been sold

<table>
<thead>
<tr>
<th></th>
<th>Performance over Next 84 Trading Days</th>
<th>Performance over Next 252 Trading Days</th>
<th>Performance over Next 504 Trading Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average excess return on winning stocks sold</td>
<td>0.0047</td>
<td>0.0235</td>
<td>0.0645</td>
</tr>
<tr>
<td>Average excess return on paper losses</td>
<td>$-0.0056$</td>
<td>$-0.0106$</td>
<td>0.0287</td>
</tr>
<tr>
<td>Difference in excess returns ($p$-values)</td>
<td>0.0103</td>
<td>0.0341</td>
<td>0.0358</td>
</tr>
</tbody>
</table>
• Alternative Explanation 3: **Transaction costs** $\rightarrow$ Losers more costly to trade (lower prices)

  - Compute equivalent of $PGR$ and $PLR$ for additional purchases of stock

  - This story implies $PGP > PLP$

  - Prospect Theory implies $PGP < PLP$ (invest in losses)

• Evidence:

\[
P_{\text{GP}} = \frac{\text{Gains Purchased}}{\text{Gains Purchased} + \text{Paper Gains}} = 0.094
\]

\[
< PLP = \frac{\text{Losses Purchased}}{\text{Losses Purchased} + \text{Paper Losses}} = 0.135.
\]
• Alternative Explanation 4: **Belief in Mean Reversion** $\rightarrow$ Believe that losers outperform winners
  
  – Behavioral explanation: Losers do not outperform winners
  
  – Predicts that people will buy new losers $\rightarrow$ Not true

• How big of a cost? Assume $1000 winner and $1000 loser
  
  – Winner compared to loser has about $850 in capital gain $\rightarrow$ $130 in taxes at 15% marginal tax rate
  
  – Cost 1: Delaying by one year the $130 tax ded. $\rightarrow$ $10
  
  – Cost 2: Winners overperform by about 3% per year $\rightarrow$ $34
• Are results robust to time period and methodology?

• Ivkovich, Poterba, and Weissbenner (2006)

• Data
  – 78,000 individual investors in Large discount brokerage, 1991-1996
  – Compare taxable accounts and tax-deferred plans (IRAs)
  – Disposition effect should be stronger for tax-deferred plans
• Methodology: Do hazard regressions of probability of buying and selling monthly, instead of \( PGR \) and \( PLR \)

• For each month \( t \), estimate linear probability model:

\[
SELL_{i,t} = \alpha_t + \beta_{1,t} I(Gain)_{i,t-1} + \beta_{2,t} I(Loss)_{i,t-1} + \varepsilon_{i,t}
\]

• Regression only applies to shares not already sold

• \( \alpha_t \) is baseline hazard at month \( t \)

• Pattern of \( \beta \)'s always consistent with disposition effect, except in December

• Difference is small for tax-deferred accounts
Figure 1: Hazard Rate of Having Sold Stock in Taxable Accounts, Full Sample

Note: Sample is January purchases of stock 1991-96 in taxable accounts. The hazard rate for stock purchases unconditional on the stock’s price performance, as well as conditional on whether the stock has an accrued capital gain or loss entering the month, is displayed.
Figure 2: Hazard Rate of Having Sold Stock in Taxable and Tax-Deferred Accounts, Original Buy at least $10,000

Notes: Sample is January purchases of stock of at least $10,000 from 1991-96. The hazard rate for stock purchases conditional on whether the stock has an accrued capital gain or loss entering the month is displayed for taxable and tax-deferred accounts.
- Plot difference in hazards between taxable and tax-deferred account

- Taxes also matter
• Disposition Effect is very solid finding

• **Barberis and Xiong (Forthcoming).** Model asset prices with full prospect theory (loss aversion+concavity+convexity), except for prob. weighting

• Under what conditions prospect theory generates disposition effect?

• Setup:
  - Individuals can invest in risky asset or riskless asset with return $R_f$
  - Can trade in $t = 0, 1, \ldots, T$ periods
  - Utility is evaluated only at end point, after $T$ periods
  - Reference point is initial wealth times risk-free rate $W_0 R_f$
  - Utility is $v \left( W_T - W_0 R_f \right)$
- Calibrated model: Prospect theory may not generate disposition effect!

Table 2: For a given \((\mu, T)\) pair, we construct an artificial dataset of how 10,000 investors with prospect theory preferences, each of whom owns \(N_g\) stocks, each of which has an annual gross expected return \(\mu\), would trade those stocks over \(T\) periods. For each \((\mu, T)\) pair, we use the artificial dataset to compute PGR and PLR, where PGR is the proportion of gains realized by all investors over the entire trading period, and PLR is the proportion of losses realized. The table reports “PGR/PLR” for each \((\mu, T)\) pair. Boldface type identifies cases where the disposition effect fails (PGR < PLR). A hyphen indicates that the expected return is so low that the investor does not buy any stock at all.

<table>
<thead>
<tr>
<th>(\mu)</th>
<th>(T = 2)</th>
<th>(T = 4)</th>
<th>(T = 6)</th>
<th>(T = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.03</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.55/.50</td>
</tr>
<tr>
<td>1.04</td>
<td>-</td>
<td>-</td>
<td>.54/.52</td>
<td>.54/.52</td>
</tr>
<tr>
<td>1.05</td>
<td>-</td>
<td>-</td>
<td>.54/.52</td>
<td>.59/.45</td>
</tr>
<tr>
<td>1.06</td>
<td>-</td>
<td>.70/.25</td>
<td>.54/.52</td>
<td>.58/.47</td>
</tr>
<tr>
<td>1.07</td>
<td>-</td>
<td>.70/.25</td>
<td>.54/.52</td>
<td>.57/.49</td>
</tr>
<tr>
<td>1.08</td>
<td>-</td>
<td>.70/.25</td>
<td>.48/.58</td>
<td>.47/.60</td>
</tr>
<tr>
<td>1.09</td>
<td>-</td>
<td>.70/.25</td>
<td>.43/.70</td>
<td>.48/.58</td>
</tr>
<tr>
<td>1.10</td>
<td>0.0/1.0</td>
<td>.43/.70</td>
<td>.48/.58</td>
<td>.36/.69</td>
</tr>
<tr>
<td>1.11</td>
<td>0.0/1.0</td>
<td>.43/.70</td>
<td>.49/.58</td>
<td>.37/.68</td>
</tr>
<tr>
<td>1.12</td>
<td>0.0/1.0</td>
<td>.28/.77</td>
<td>.23/.81</td>
<td>.40/.66</td>
</tr>
<tr>
<td>1.13</td>
<td>0.0/1.0</td>
<td>.28/.77</td>
<td>.24/.83</td>
<td>.25/.78</td>
</tr>
</tbody>
</table>
• Intuition:
  – Previous analysis of reference-dependence and disposition effect focused on concavity and convexity of utility function
  – Neglect of kink at reference point (loss aversion) \(\rightarrow\) First-order risk aversion around kink
  – Loss aversion induces high risk-aversion around the kink \(\rightarrow\) Two effects
    1. Agents purchase risky stock only if it has high expected return
    2. Agents tend to sell if price of stock is around reference point
  – Now, assume that returns are high enough and one invests:
    * on gain side, likely to be far from reference point \(\rightarrow\) hold shares ‘up to kink’ \(\rightarrow\) Hold shares despite (moderate) concavity
    * on loss side, likely to be close to reference point \(\rightarrow\) hold shares ‘up to kink’ (closer) \(\rightarrow\) Hold fewer shares, despite (moderate) convexity
Some novel predictions of this model:

- Stocks near buying price are more likely to be sold
- Disposition effect should hold when away from ref. point
• Barberis-Xiong assumes that utility is evaluated every $T$ periods for all stocks

• Alternative assumption: Investors evaluate utility only when selling
  
  – Loss from selling loser and Gain from selling winner
  
  – $\rightarrow$ Sell winners, hoping in option value
  
  – Would induce bunching at exactly purchase price

• Key question: When is utility evaluated?
• Karlsson, Loewenstein, and Seppi: Ostrich Effect
  – Investors do not want to evaluate their investments at a loss
  – Stock market down → Fewer logins into investment account

Figure 4b: Changes in the SAX and ratio of fund look-ups to logins to personal banking page by investors at a large Swedish bank
The sample period is June 30, 2003 through October 7, 2003.
3 Reference Dependence: Equity Premium

- Disposition Effect is about cross-sectional returns and trading behavior →
  Compare winners to losers

- Now consider reference dependence and market-wide returns

- Benartzi and Thaler (1995)

  - Equity premium (Mehra and Prescott, 1985)
    - Stocks not so risky
    - Do not covary much with GDP growth
    - BUT equity premium 3.9% over bond returns (US, 1871-1993)

- Need very high risk aversion: $RRA \geq 20$
• Benartzi and Thaler: Loss aversion + narrow framing solve puzzle
  – Loss aversion from (nominal) losses—> Deter from stocks
  – Narrow framing: Evaluate returns from stocks every $n$ months

• More frequent evaluation—>Losses more likely —> Fewer stock holdings

• Calibrate model with $\lambda$ (loss aversion) 2.25 and full prospect theory specification —> Horizon $n$ at which investors are indifferent between stocks and bonds
• If evaluate every year, indifferent between stocks and bonds

• (Similar results with piecewise linear utility)

• Alternative way to see results: Equity premium implied as function on $n$
• Barberis, Huang, and Santos (2001)

• Piecewise linear utility, $\lambda = 2.25$

• Narrow framing at aggregate stock level

• Range of implications for asset pricing

• Barberis and Huang (2001)

• Narrowly frame at individual stock level (or mutual fund)
4 Reference Dependence: Employment and Effort

- Back to labor markets: Do reference points affect performance?

- Mas (2006) examines police performance

- Exploits quasi-random variation in pay due to arbitration

- Background
  
  - 60 days for negotiation of police contract $\rightarrow$ If undecided, arbitration
  
  - 9 percent of police labor contracts decided with final offer arbitration
• Framework:

- pay is \( w * (1 + r) \)

- union proposes \( r_u \), employer proposes \( r_e \), arbitrator prefers \( r_a \)

- arbitrator chooses \( r_e \) if \( |r_e - r_a| \leq |r_u - r_a| \)

- \( P(r_e, r_u) \) is probability that arbitrator chooses \( r_e \)

- Distribution of \( r_a \) is common knowledge (cdf \( F \))

- Assume \( r_e \leq r_a \leq r_u \) → Then

\[
P = P(r_a - r_e \leq r_u - r_a) = P(r_a \leq (r_u + r_e) / 2) = F\left(\frac{r_u + r_e}{2}\right)
\]
• Nash Equilibrium:

  – If \( r_a \) is certain, Hotelling game: convergence of \( r_e \) and \( r_u \) to \( r_a \)

  – Employer’s problem:

    \[
    \max_{r_e} PU(w(1 + r_e)) + (1 - P)U(w(1 + r_u^*))
    \]

    – Notice: \( U' < 0 \)

  – First order condition (assume \( r_u \geq r_e \)):

    \[
    \frac{P'}{2} [U(w(1 + r_e^*)) - U(w(1 + r_u^*))] + PU'(w(1 + r_e^*))w = 0
    \]

    – \( r_e^* = r_u^* \) cannot be solution \( \rightarrow \) Lower \( r_e \) and increase utility (\( U' < 0 \))
– Union’s problem: maximizes

\[
\max_{r_u} PV \left( w \left( 1 + r_e^* \right) \right) + (1 - P) V \left( w \left( 1 + r_u \right) \right)
\]

– Notice: \( V' > 0 \)

– First order condition for union:

\[
\frac{P'}{2} \left[ V \left( w \left( 1 + r_e^* \right) \right) - V \left( w \left( 1 + r_u^* \right) \right) \right] + (1 - P) V' \left( w \left( 1 + r_e^* \right) \right) w = 0
\]

– To simplify, assume \( U \left( x \right) = -bx \) and \( V \left( x \right) = bx \)

– This implies \( V \left( w \left( 1 + r_e^* \right) \right) - V \left( w \left( 1 + r_u^* \right) \right) = -U \left( w \left( 1 + r_e^* \right) \right) - U \left( w \left( 1 + r_u^* \right) \right) \rightarrow \)

\[
-bP^* w = - (1 - P^*) bw
\]
Result: \( P^* = \frac{1}{2} \)

• Prediction (i) in Mas (2006): "If disputing parties are equally risk-averse, the winner in arbitration is determined by a coin toss."

• Therefore, as-if random assignment of winner

• Use to study impact of pay on police effort

• Data:
  - 383 arbitration cases in New Jersey, 1978-1995
  - Observe offers submitted \( r_e, r_u \), and ruling \( \bar{r}_a \)
  - Match to UCR crime clearance data (number of crimes solved by arrest)
- Compare summary statistics of cases when employer and when police wins
- Estimated $\hat{p} = .344 \neq 1/2 \Rightarrow$ Unions more risk-averse than employers
- No systematic difference between Union and Employer cases except for $r_e$
• Graphical evidence of effect of ruling on crime clearance rate

![Graph showing clearance rates over time](image)

• Significant effect on clearance rate for one year after ruling

• Estimate of the cumulated difference between Employer and Union cities on clearance rates and crime
- Arbitration leads to an average increase of 15 clearances out of 100,000 each month
- Effects on crime rate more imprecise

<table>
<thead>
<tr>
<th></th>
<th>All crime</th>
<th>Violent crime</th>
<th>Property crime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Constant</td>
<td>612.18</td>
<td>150.25</td>
<td>461.81</td>
</tr>
<tr>
<td></td>
<td>(63.98)</td>
<td>(23.22)</td>
<td>(42.00)</td>
</tr>
<tr>
<td>Post-arbitration</td>
<td>26.86</td>
<td>24.68</td>
<td>7.75</td>
</tr>
<tr>
<td>× Employer win</td>
<td>(23.29)</td>
<td>(14.68)</td>
<td>(7.83)</td>
</tr>
<tr>
<td>Post-arbitration</td>
<td>7.64</td>
<td>6.68</td>
<td>7.07</td>
</tr>
<tr>
<td>× Union win</td>
<td>(16.24)</td>
<td>(11.42)</td>
<td>(5.46)</td>
</tr>
<tr>
<td>Row 3 – Row 2</td>
<td>-19.21</td>
<td>-18.01</td>
<td>-0.68</td>
</tr>
<tr>
<td></td>
<td>(50.06)</td>
<td>(19.12)</td>
<td>(9.36)</td>
</tr>
<tr>
<td>Employer Win (Yes = 1)</td>
<td>-31.81</td>
<td>-20.43</td>
<td>-11.35</td>
</tr>
<tr>
<td></td>
<td>(84.42)</td>
<td>(27.57)</td>
<td>(39.30)</td>
</tr>
<tr>
<td>Fixed-effects?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mean of the dependent variable</td>
<td>[364.23]</td>
<td>[2037.4]</td>
<td>[163.18]</td>
</tr>
<tr>
<td>Sample size</td>
<td>9,328</td>
<td>59,060</td>
<td>9,529</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.001</td>
<td>0.54</td>
<td>0.007</td>
</tr>
</tbody>
</table>
• Do reference points matter?

• Plot impact on clearances rates (12, -12) as a function of $\bar{r}_a - (r_e + r_u)/2$
- Effect of loss is larger than effect of gain
• Column (3): Effect of a gain relative to \((r_e + r_u)/2\) is not significant; effect of a loss is

• Columns (5) and (6): Predict expected award \(\hat{r}_a\) using covariates, then compute \(\bar{r}_a - \hat{r}_a\)

  - \(\bar{r}_a - \hat{r}_a\) does not matter if union wins
  - \(\bar{r}_a - \hat{r}_a\) matters a lot if union loses

• Assume policeman maximizes

\[
\max_e \left[ \bar{U} + U(w) \right] e - \theta \frac{e^2}{2}
\]
where

\[ U(w) = \begin{cases} 
  w - \hat{w} & \text{if } w \geq \hat{w} \\
  \lambda (w - \hat{w}) & \text{if } w < \hat{w}
\end{cases} \]

- F.o.c.:

\[ \bar{U} + U(w) - \theta e = 0 \]

Then

\[ e^*(w) = \frac{\bar{U}}{\theta} + \frac{1}{\theta} U(w) \]

- It implies that we would estimate

\[ Clearances = \alpha + \beta (\bar{r}_a - \hat{r}_a) + \gamma (\bar{r}_a - \hat{r}_a) \mathbf{1} (\bar{r}_a - \hat{r}_a < 0) + \varepsilon \]

with \( \beta > 0 \) (also \textit{in} standard model) and \( \gamma > 0 \) (not in standard model)
• Compare to observed pattern

• Close to predictions of model
5 Next Lecture

- Social Preferences
  - Charitable Giving
  - Gift Exchange
  - Workplace
  - From Lab to Field